

Salivary glands

(1)

Major $\Rightarrow$ 90% of vol. of saliva

- Compound tubulo-alveolar
- paired 2 parotid, 2 submandibular, 2 sublingual

Functions of saliva p. 42

Minor 10%

- branched tubulo-alv.
- scattered in oral mucosa of lip, tongue, cheeks, palate, tonsil
labial lingual buccal palatine
von Ebner's

Parotid Gland

def.: The largest salivary gland, exocrine, comp. tubulo-alveolar, purely serous gland in front of both ears. Formed of:

• Stroma:

a. Capsule := c.t. cells (mainly fibroblasts) & fibres (collagenous & elastic) thick, rich in fat cells. covered by fascia & skin.

b. Trabeculae := c.t. cells & fibres thick, rich in fat cells. descend from capsule to divide the gland into lobes & lobules. carry bl. vs. nerves & ducts.

c. Reticular c.t. := ret. cells & fibres in the background. stained w/ Ag.

• Parenchyma:

Formed of Serous acini & duct system.

Serous acini:

- Have small diameter & narrow lumen, lined by serous cells.
- Serous cells are pyramidal cells & central rounded nuclei.
- Have non-clear cell boundaries & joined by junctional complexes.
- Cytoplasm is deeply basophilic rich in mit, r-ER, well developed G.A. & apical zymogen granules.
- Secrete serous fluid rich in amylase for hydrolysis of carbohydrates.
- The acini are surrounded by Myoepithelial cells = Basket cells.
- Branched stellate cells that surround the acini & ducts. present bet. the basal part of the cells & the basement memb. rich in actin & myosin. their contraction discharge the secretion to the ducts. & prevent distention of acini (11 intraluminal press) during secretion.

Duct System:

1. Intercalated ducts:

- the 1st ducts w/ arise from the acini - lined by s. cubical epith. join to form

2. Intra-lobular [striated] duct:

- Inside the lobules. lined by s. cuboidal cells & central rounded nuclei.
- Cytoplasm is acidophilic & basal acidophilic striations.

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elongated mit. - have secretory function & drain into →

3. Inter-lobular duct [excretory]:

In the septa bet. the lobules. lined e' s.col. epith. join to form →

4. Inter-lobar duct:

In the septa bet. the lobes, lined e' pseudo-st.col. " " " " →

5. The main duct [Stensen's duct]

lined e' stratified col. epith. w changes into str. squamous at its opening in the mouth cavity.

(N.B) The c.t. stroma contains many lymphocytes & plasma cells w secrete Ig A that together e' secretions produced by serous acini intercalated & striated ducts ⇒ Ig A-secretory complex (resistant to digestion) w defend against infection by pathogens in the oral cavity.

Types of acini

① Serous acinus	② Mucous Acinus
diameter - small lumen - narrow Cells - pyramidal cells e' non-clear boundaries - central rounded nucleus - deeply basophilic cytoplasm e' apical zymogen granules Function - secrete serous fluid Basket cells - few	- larger - wide - cuboidal cells e' clear boundaries - basal & flat nucleus - pale vacuolated (dissolved mucin) - mucous. - numerous.

③ Mucoserous acini:

a mucous acinus having on one side a crescent of basophilic serous cells = Crescent of Gianuzzi or Serous demilunes.

Function: secrete mucoserous secretion.

Major Salivary Glands

Exocrine, compound tubulo-alveolar glands, secrete 90% of total vol. of saliva. They include:

	Parotid (largest)	Submandibular	Sublingual (smallest)
Site	- in front of both ears	- innerside of the mandible	- under mucosa of floor of mouth.
Capsule	- very thick, rich in fat cells	- thick	- thin
Trabeculae	- thick, rich in fat cells	- abundant trabeculae	- thick trabeculae
Parenchyma	- divide the gl. into lobes & lobules	- divide -----	- divide -----
Acini	- carry bl. vs, ns, lymph vs, ducts	- carry -----	- carry -----
	Serous: - purely serous - contain zymogen w contain <u>amylase</u> for hydrolysis of CHO	Seromucous: • In humans, 90% <u>serous</u> 10% <u>mucous</u> + <u>mucoserous</u> (N.B.) in dog mostly mucous • zymogen contain <u>lysozyme</u> w kill bact.	mucoserous: - <u>mucous</u> acini predominate <u>mucoserous</u> acini but - No <u>pure</u> <u>serous</u> acini
duct system	Similar to that of large salivary gls <u>the main duct</u> = <u>Stensen's d.</u> opens in innerside of cheek opposite 2nd upper molar tooth	- same - <u>Wharton's duct</u> opens on floor of mouth cavity	- same - either [joins submandibular duct or [open separately on floor of mouth cavity.

Pancreas

- 4 -

def.: A mixed gl. → Exocrine part = Comp. tubulo-alveolar, serous → p. juice.
→ Endocrine " = Islet of Langerhans → p. hormones.

Formed of:

Stroma:

1. Capsule: c.t. cells () & Fibres (). Thin, covered e' peritoneum
2. Trabeculae: c.t. cells () . Thin, delicate, descend from capsule to divide the gl. into indistinct lobes & lobules.
3. Reticular c.t.: reticular cells & fibres. In the background. • stained e' Ag.

Parenchyma:

Exocrine part:

1] Acini:

L.M. Have small diameter & narrow lumen.

- lined e' pyramidal cells e' non-clear boundaries.
- have basal rounded pale nuclei e' prominent nucleoli
- have basal basophilic cytopl. & apical acidophilic zymogen granules.

Centro-acinose Cells:

Flat cells lining the lumen of acini. They represent the invaginated or telescoped part of the intercalated duct.

E.M. - the cell membs. are joined by junctional complexes.

- basal basophilia due to many cisternae of basal r-ER.
- Supranuclear well developed G.A. - many mit.
- Apical electron-dense memb. bound zymogen granules.

2] Duct System:

• Intercalated duct: narrow, lined e' s. squamous epith. they invaginate into the lumen of the acinus → centro-acinar cells.

• Intra. lobular duct: absent.

• Inter. lobular " : lined e' s. cubical epith.

• Inter. lobar " : " s. col. "

• Main pancreatic " : " s. col. + goblet cells & entero-endocrine.

(N.B) The exocrine secretion is controlled by 2 hrs. secreted by enteroendoc cells of G.I.T.

Cholecystikinin, pancreazimin: stimulate acinar cells to produce and secrete

Biliary tract [Passages]

(1) Bile Canaliculi:

- receive bile secreted by the liver cells.
- limited by the cell memb. of hepatocytes in the 2 rows.
- short microvilli project from the liver cells into the canaliculi.
- bile flows from the centre of the lobule to the periphery i.e. opposite the direction of blood. They empty in →

(2) Canal of Hering [ductule]:

- lined e' s. cubical epith. receives bile from canaliculi & drain into:

(3) Inter-lobular bile duct:

- In the portal canal, lined e' s. cubical. Fuse to form →

(4) Rt. & Left hepatic ducts:

- the intrahepatic part is lined e' s. cubical epith.
- " extra " " " " " s. columnar " . They fuse to form →

(5) Common Hepatic duct:

- lined e' s. col. epith surrounded by c.t. & smooth ms.
- Joins the cystic duct to form the common bile duct.

(6) Cystic duct:

arise from the gall bladder, lined e' s. col. epith. surrounded by c.t. & sm. ms.

(7) Common bile duct: lined " " " " " " " " " "

the c.t. under the epith. contains mucous glands
the muscle is thickened near the duod. to form **sphincter of Oddi** to regulate bile flow.

The Gall Bladder

def A pear shaped hollow organ attached to the lower surface of liver.

Function: stores, concentrates bile & adds mucous. Formed of:

1. Mucosa: (highly folded)

- a. s. col. epith: provided e' microvilli (absorb H_2O) & can secrete mucous.
 - b. lamina propria: rich in bl. vs & tubuloalveolar mucous gls.
- No muscularis mucosa, so no submucosa.

2. Musculosa: i

irregular smooth ms e' elastic & collagenous fs in bet.

3. Serosa: covered e' peritoneum (except hepatic surface)

Endocrine part:

- pale areas among the dark acini.
- about 1 million but mainly in the tail.
- Non-capsulated but supported by reticular c.t.
- Formed of masses or branching cords of cells separated by $\rightarrow$ Penetrated capillaries or bl. sinusoids. Contain 7 types of cells:

①. Beta β - cells	②. Alpha α - cells
• more numerous 70%. • smaller diameter (10-15 μm). • centrally located. • Basophilic grs. (alcohol soluble) • E.M. rich in mit., well developed G.A., rER., memb. bound electron dense grs. • Functⁿ: secrete insulin $\bar{w}$ ↳ lowers bl. sugar. ↳ help glycogenesis.	- less numerous 15%. - larger (15-25 μm). - peripherally situated. - Acidophilic grs. (H₂O soluble). - secrete glucagon $\bar{w}$ ↑↑ bl. sugar.

③. Delta (δ) cells:

- 10% of the cells. peripherally situated.
- contain secretory granules $\bar{w}$ stain e' Ag.
- Functⁿ: secrete somatostatin = anti growth hr. control release of insulin & glucagon

④. C. cells:

- very few (3%), have few organelles, few granules.
- F: unknown: may be immature or degranulated cells.

⑤. F (P.P.) cells:

- very few, few organelles, few granules.
- F: secrete pancreatic polypeptide $\bar{w}$ reduces pancreatic secretion.

⑥. G. cells: secrete gastrin.

⑦. Ganglion Cells: sympathetic n. cells $\rightarrow$ autonomic nervous control of islet secret

Parotid	Pancreas
Exocrine (pair) in front of both ears	- mixed (single). - in concavity of duod.
<u>Capsule</u> : thick, rich in fat covered e' fascia then skin	- thin & delicate, no fat. - covered e' peritoneum.
<u>trabeculae</u> : thick → distinct lobulation	- thin → indistinct lobulation.
<u>Acini</u> have basophilic cytoplasm & central rounded nuclei	- Basal basophilic cytopl. & apical acidophilic zymogen granules + basal rounded nuclei.
<u>Basket</u> - present. <u>cells</u>	- absent.
<u>Centroacinar</u> : absent. <u>cells</u>	- present.
<u>Intercalated</u> : not invaginated. <u>duct</u>	- invaginated.
<u>Intra lobular</u> . present.	- absent.
<u>Main duct</u> : lined e' st. col. then st. sq. at it's opening in mouth cavity	- lined e' s. col. + goblet cells + enters endocrine cells
<u>Islets of Langerhans</u> : absent	- present.

Liver

def: The largest metabolic gland. Mixed gland → Exocrine = comp. tubular → bile
→ endocrine → glucose, plasma-proteins & lipoproteins → blood.

Functions:

1. Form bile
2. Form plasma proteins, a.a.s, uric A & urea.
3. storage of glycogen, vitamins [KDA & B] & minerals [Fe & Cu].
4. detoxification of drugs & hormones.
5. destruction of old RBCs & dead cells by macrophages.
6. Metabolism of CHO, lipids & proteins.
7. Secrete Ig A & M.

Structure:

I. Stroma:

A. Capsule [Glisson's]:

= C.T. cells & fibres

thin, partially covered by peritoneum.

B. Trabeculae:

C.T. cells

& fibres, delicate in human → non-clear lobulation but in pig & in man (in case of cirrhosis) it is very thick. It is condensed at the corners of the lobules surrounding bl. vs & bile ducts.

C. Reticular C.T.:

reticular cells & fibres in the background stained by Ag.

II Parenchyma:

Both exocrine & endocrine functions are carried by the structural unit [Hepatocyte] which are arranged in ① Classic hepatic lobule ② Portal lobule ③ Liver sinusoids

1. Classic Hepatic lobule

def: Hexagonal mass of liver cells draining their venous blood into a central vein. demarcated by thin trabeculae which are thickened at the corners →

Portal tracts or Canals:

condensed C.T. at the corners bet. hepatic lobules. It contains:

- ① A branch of portal vein: the widest.
- ② " " " hepatic artery: rounded, narrow lumen
- ③ A bile duct (Cub. epith)
- ④ A lymph vessel.

Liver cells are arranged in the form of cords [or plates] radiating from the central vein. The cords are separated by bl. sinusoids. Each cord is formed of 2 rows enclosing a bile canaliculus. The fenestrated endoth. of bl. sinusoids is separated from hepatocytes by space of Disse.

Liver Cell [Hepatocyte]

- 2-

L.M. large polyhedral cell e' central 1 or 2 nuclei: pale, vesicular e' prominent 1 or 2 nucleoli & acidophilic (mit. & SER) & vacuolated cytoplasm (dissolved) glycogen. Glycogen (stained e' PAS or Best's Carmine).

E.M. [1] - Cell Membrane:

- a. surface facing bl. sinusoid shows long Microvilli for transfer of materials bet. liver cell & bl. sinusoid
- b. " " bile canaliculus " short " "
- c. " " adjacent hepatocyte " junctional complexes.

[2] Cytoplasm: contains all organelles & inclusions:

a. Mitochondria: numerous 1000-2000/cell → energy production.

b. free ribosomes → ptn. to build the cell

c. r-ER → form plasma proteins.

d. s-ER: abundant → synthesis of cholesterol, phospholipids.
→ detoxification of drugs & hrs.
→ break down & storage of glycogen.

e. G.A. well developed: → secretion
→ form lysosomes.
→ turnover of cell memb.

f. lysosomes: numerous → destroy old components or organelles.
→ eliminate waste products.

g. Microbodies [peroxisomes]: v. numerous for metabolism of H_2O_2
" " etc.
→ degradation of lipids.

Inclusions: a. fat droplets.

b. glycogen = electron dense granules.

Bl. Sinusoids:

Irregular bl. spaces radially arranged bet. the hepatic plates (demonstrated when injected e' gelatin Carmine). Lined e' 2 types of cells:

(1) fenestrated endothelial cells.

(2) von Kupffer cells:

- branched phagocytic cells e' pseudopodia lining liver sinusoids.
- Origin: bl. monocytes. - sp. stain: vital stain (trypan blue)
- Cytoplasm is vacuolated rich in lysosomes & phagocytic vesicles

Functions:

1. Clean bl. passing from portal vein to central vein from foreign material → prevent obstruction of bl. sinusoids.
2. destruction of old RBCs & form bile pigments.
3. phagocytose any bact. or microorganism coming from the intestine.

Space of Disse [Perisinusoidal space]

- It is the space bet. hepatocytes & bl. sinusoids.

- Contains:

- long microvilli projecting from hepatocyte (↑ surface area bet. hepatocytes & plasma)
- plasma containing nutrients.
- reticular fibres [support the wall of the sinusoid].
- Ito cells: branching fat storing cells store vit. A in fat droplets as retinyl ester.

2. Portal lobule

def: a triangular mass of liver cells including parts of 3 adjacent hepatic lobules. It drains its bile into the bile duct in the portal canal in the centre of the lobule. Has 3 central veins at the apices of the lobule.

3. Liver Acinus

def: a diamond shaped mass of liver cells including parts of 2 adj. hepatic lobules. It has a central vascular core = branch of a hepatic art. & branch of a portal vein that arise at right angle from the portal canal.

- It is divided into 3 zones:

- Zone I: close to the vascular core rich in bl. supply [1st to receive glucose + O_2]
- Zone II: intermediate zone, less bl. supply than Zone I.
- Zone III: At the periphery of acinus farthest from vascular core & nearest to central vein. poor in bl. supply [Least O_2 & glucose].

This explains why in certain diseases some cells are more affected than the others.

Bl. Supply of liver

75% of the bl. supply comes from the portal vein [nutrient rich but O_2 poor] while 25% " " " hepatic art [O_2 rich]. They pour from periphery to centre of the lobule (in bl. sinusoids).

The Gall bladder

Pear shaped organ attached to the lower surface of the liver.

Function: stores & concentrates bile & adds mucus. Formed cfa

Structure:

1. Mucosa: highly folded (no villi & no crypts).

= simple col. epith. → e' apical microvilli (to absorb H_2O)

↳ secrete mucus

• lamina propria = c.t. rich in bl. vs & tubuloalveolar mucous gls

• no muscularis mucosa. no submucosa.

2. Musculosa:

irregular smooth ms + collagenous & elastic fibres.

3. Serosa: except at the hepatic surface.